Framework for solving inverse problems

Based on FrEIA and Cement

Overview

- What is NF4IP?
- Why NF4IP?
- Whats the difference to FrEIA?
- What is Cement?
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Overview

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- Application object and Controllers
- Configuration
- Logging
- Runs / Checkpoints
- Hooks / Filters
- Interfaces and Handlers

What is NF4IP?

- A Library/Framework that helps with inverse problems
- Based on FrEIA and Cement
- Configurable, customizable and extendable

Why NF4IP?

- Avoid Code-Duplication across projects
- Cleaner, shorter and more maintainable code
- Avoid re-inventing the wheel (configuration, checkpointing...)
- Make solving inverse problems more easy.

Whats the difference to FrEIA?

- FrEIA is a Toolbox for Building invertible networks
- NF4IP uses this toolbox and delivers prebuilt networks and adds common features.

What is Cement?

- A Python Framework for building command-line Applications
- Fully featured
  - Config, logging, extensions, plugins, hooks, controllers, output handlers

NF4IP Features

- Comes with an INN, VAE and abstract model
- Project-Code-Generator
- Configuration system
- Logging system
- Hook/Filter system
- Plugin/Extension system
- Checkpointing
- Horovod and Tensorboard support

Installation

```
git clone https://github.com/Photon-AI-Research/NF4IP.git


cd NF4IP
pip install -r requirements.txt
pip install -e setup.py
```

Generating your first Project

- “NF4IP generate project <folder>”
- Gives a ready to use project as starting point
- Setuptools, virtualenv, tests, ...

Application object

- Defined in myapp/main.py
- Available almost everywhere
- Inherits from NF4IP Application class
- Configures the basics (Plugins, Handlers, Paths)

Controller object

- Represents subcommands that do “something”
- Holds the applications logic

Configuration

- Powerful system for all you Configuration needs
- Configurations are merged with priority:
  - Default module configuration
  - Project configuration
  - Extra --config configuration
  - Command line options
- Accessible and setable through the application object (app.config.get/set)

Logging

- Log using app.log.debug/info/warning/error/fatal
- Configurable to log to file and/or console
- Logging format and level is customizable

Run/Checkpoint

- Parameter --run allows you to name your run
- Enables automatic checkpointing and resume using that name
- --overwrite overwrite the checkpoint and restarts the training
- The run name is also used on the tensorboard and progressbar output

Hooks and Filters

- Allows to “Hook” your own callbacks into the frameworks Core
- Multiple callbacks per Hook/Filter are allowed
- Are executed by priority and order definition
  - Default priority is 0, negative numbers have higher priority
- --debug helps following the callbacks

Hooks vs Filters

- Hooks are commonly used for reporting purposes or for triggering your own logic
- Filters always return their arguments and can alter them
  - Multiple filters on the same name are executed in sequence with the return value of the previous filter passed to the next

Important Cement Hooks

- post/pre_setup: if you need to initialize something early
- post_argument_parsing / pre_run: if you need to do something based on arguments but before your controller is executing
- pre_close: cleanup stuff

NF4IP Hooks

- pre/post_training
- pre/post_epoch
- post_validate: add your own validation or visualization code

NF4IP Filters

- train_input / val_input: if transformations are needed
- train_(forward|backward|backward_rand)_output
- checkpoint_save/restore: add you own data to the checkpoint

Hooks, Filters, Plugins, Extensions

- You can define your own extensions, hooks and filters
  - Look at the progressbar extension for a simple example
- A Cement plugin is used within your application while an cement extension can be part of the library

Interfaces and Handlers

- Are used for fully customizing parts of the project
- Interfaces define methods and parameters while handlers implement them
- The actual handler can be selected by a configuration value
  - Example: inn_network_factory

Contributing

- NF4IP is a young project that does not (yet) fit every use-case and its api may change
- You can build our own network architectures on the AbstractModel class.
- If you have improvements to the core or useful extensions, please create a merge request!